REMARKS

The Applicants appreciate the Examiner's thorough examination of the subject application. Applicants request reconsideration of the subject application based on the following remarks.

Claims 1-9 have been amended and new claims 10-12 have been added. Support for the amendments to claims 1-9 can be found throughout the specification. Support for new claim 10 can be found in original claim 7. Support for new claims 11 and 12 can be found in the specification at page 6, lines 11 to page 7, line 3 and at page 8, lines 4-12. No new matter has been introduced by the instant amendments.

Claims 1-9 was rejected under 35 U.S.C. §112, second paragraph, as being allegedly indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

In particular, Applicants note that the terms "ionotropically orientable polyanion" and "ionotropic gel" are well known in the art. For example, the English translation of the entries *"ionotropic gels"* and *"ionotropy"* of Römpp's Chemical Dictionary, 9th edition, 1989, page 2042 provides that:

> *"ionotropic gels".* Birefringent, highly elastic, reversibly swellable and ion exchanging *gels consisting of regular, threadlike molecules producible via *ionotropy described by H. *Thiele for the first time. *Alginic acid and Na-*alginate with Cu^{2+} as a counter ion are particularly suitable model substances, respectively. - *D* ionotrope Gele - *F* gels inotropiques - *I* gel ionotropi - *S* geles ionotrópicos
>
> *Lit.:* cf. ionotropy
>
> *"ionotropy".* Term established by H. Thiele relating to "regularly arranging threadlike molecules by means of ion diffusion". By directed diffusion of ions into *sols of linear

> *macromolecules or colloids (cf. chemistry of colloids) having a fibrous structure corresponding to unlike charges *ionotropic gels are producible whose structures are surprisingly similar to those of biological materials. When biological materials are carefully decomposed by colloid chemical processes ("histolysis"), the biological structures can be recombined ("histogenesis") via ionotropy. Therefore, ionotropy is attributed to possess a principle relevance in the formation of biological structures. Ionotropy is practically important e.g. for the production of very well compatible surgical implants, such as blood vessels, dermis and the like. - *D* Ionotropie - *F* inotropie - *I* ionotropia - *S* ionotropia
>
> *Lit.:* cf. Thiele, Histolysis and Histogenesis, Tissues and ionotropic Gels, Principle of a Structure Formation, Frankfurt: Akademische Verlagsges. 1967.

Thus one of ordinary skill in the art would comprehend the meaning of the terms "ionotropically orientable polyanion" and "ionotropic gel" as these terms are used in the instant application.

Applicants believe that the claims as amended are fully compliant with the requirements of 35 U.S.C. §112 including the requirements of 35 U.S.C. §112, second paragraph.

Reconsideration and withdrawal of each of the §112 rejections are thus requested.

Claims 1-9 were rejected under 35 U.S.C. §102(b) as allegedly anticipated by or, in the alternative, under 35 U.S.C. §103(a), as being allegedly obvious over EP 479553 (EP'553), GB 1037502 (GB '502), Kwcon, Sterzel, Pickrell, Imhof, Johnson, Krell, Anderson ('109, '624, or '342), or Whitman.

Each of the rejections is traversed.

The present invention provides porous ceramic materials which are prepared by a sol-gel process recited in claim 1. The ceramic materials of the present invention are anisotropic and typically have a continuous capillary structure which are highly oriented. The ceramics prepared by the methods

of the instant invention offer superior physical properties and structural characteristics compared to ceramics prepared by conventional sol-gel processes.

More particularly, porous ceramic materials provided by the present invention are prepared by a method capable of imparting anisotropy to the precursor gel. Incorporation of anisotropy into the gel results in a capillary ceramic product caused by diffusion of a solution of a divalent or trivalent metal ion into the sol (step b) of claim 1) and a gradient in ion concentration (cf. page 6, lines 6 to 10 of the description).

The methods of the instant invention comprise a process step of compacting the gel structure by contacting the gel structure with an electrolyte solution such that the dimensions of the gel substance decrease. See page 9, line 14 to page 10, line 1. Thus, its particle density increases due to the electrolyte solution induced shrinkage and the mechanical strength of the product porous ceramic material increases.

The porous ceramic materials and processes of making same provided by the present invention possess reduced internal mechanical stress and reduced macroscopic deformations, in part, because the drying process used in the methods of the invention include a step of impregnating the gel with a water soluble volatile organic compound which can be removed from the gel with less disruption than removal of an equivalent amount of water.

For example, according to one preferred embodiment a porous ceramic is obtained by the following procedure (page 14 of the application): A sol is produced by introducing a boehmite suspension containing sodium sulphate into a sodium alginate sol (step a)). The resulting sol is then covered with a layer of a $Cu(NO_3)_2$ solution in the absence of convection (step b)) and allowed to mature for 10 hours wherein the gel with a capillary structure is formed. In the following steps the gel body is cut into slices, introduced into baths with increasing hydrochloric acid concentrations (step c)), and washed with water and acetone (step d)). Subsequently, the acetone is removed (step e)),

organic constituents of the dry gel body are burned out (step f)) and finally the dry gel body is sintered (step g)).

In contrast, nonc of the cited references teach or suggest an anisotropic ceramic material. Moreover, none of the citcd rcfcrences teach or suggest ceramic material having high anisotropy, e.g., materials having a continuous capillary structure. Moreover, none of thc citcd rcferences taken alone or in combination teach or suggest synthetic procedures suitable for preparing anisotropic ceramic matcrials or anisotropic gel precursors.

All of these objections refer to porous ceramic materials produced by sol-gel processcs which are in part similar to that of thc prcscnt invention. However, even if the obtained ceramic materials are actually anisotropic, there is no highly distinct anisotropy in the meaning of continuous capillarics likc in thc ccramic materials of the present application.

The cited referencces tcach ccramic materials and methods of making same differ from thc porous ccramic matcrials and methods of the present invention by at least the following specific differences.

As the reference is understood, EP A 0 479 553 recites porous ceramics which are obtained by merely adding a slurry whose components were just mixed togcther through a nozzlc into a solution of a di- ore more-valent cation to produce a gcl. Thc documcnt fails to teach or suggest compacting the gel substance by contacting thc gcl with an electrolyte.

As the reference is understood, GB 1 037 502 teaches a gel of hydratcd alumina or a mixcd gcl of alumina and at lcast onc other refractory oxidc is producd by precipitating thc gel by addition of an inorganic acid.

Kweon (US 5 962 352) appears to teach a method for fabricating porous composite oxide from a sol prepared by mixing aqueous solutions of a silicon oxide precursor and an aluminium oxide precursor, , and adding hydrochloric acid to the obtained solution. Sodium hydroxide is then added to the sol to produce a gel which is then dried.

Document US 6 399 528 (Krell et al.) relates to porous aluminium oxide structures produced by dispersing an alumina source in water by agitation and ultrasound, adding a solution or suspension of a zirconia source in order to produce a sol, pouring the sol in layers on glass shells and drying it.

Anderson patents, US 5 610 109 and US 5 439 624, recite related processes for forming porous ceramic materials. Both documents an acidified silica sol is combined with a solution or a sol comprising metal cations via a simple addition process to form a substituted gel, respectively. After evaporation of the solvent the gel is fired until the porous ceramic material is formed. In a related Anderson patent (US 5 227 342), a method of preparing a porous ceramic is recited in which an unsubstituted gel replaces the substituted gel of US 5 610 109 and US 5 439 624.

Therefore, it is evident that the ceramic or porous ceramic materials prepared by the methods recited in the above referenced documents are not anisotropic. Moreover, the methods recited in the documents relied upon in the office action are not capable of generating anisotropic gels or anisotropic porous ceramic materials at least because the methods of the cited documents comprise the use of isotropic suspensions of inorganic or organic/inorganic materials during gel formation such that no alignment or orientation of the porous structure in the gel occurs. Consequently, none of the materials prepared by the cited methods comprise oriented or aligned porous structures.

Sterzel (US 5 998 317) recites methods of preparing open-celled porous inorganic sintered products. As the document is understood, the Sterzel methods comprise a precipitation step in which a flowable mixture comprising an aqueous polymer dispersion, a sinterable inorganic powder and a

dispersant is added dropwise to a precipitation bath. The product is subsequently removed from the bath, dried, heated and sintered to a yield a porous material.

Imhof (US 6 228 340) recites macroporous ceramics and a method of producing same wherein the synthesis comprises the deposition of the gel precursor onto the droplets of an emulsified biphasic mixture during a sol-gel process.

Pickrell (US 6 235 665) provides a porous article which is produced according to a method employing polymer spheres as templates for spherical voids within the obtained ceramical article.

Johnson (US 6 368 703) teaches supported porous materials which are prepared from gels which are prepared by addition of a mixture comprising fibrous cellulose and an inorganic powder dissolved or suspended in N-methyl morpholine oxide/water into water (which induces precipitation), drying and sintering of beads obtained which are supported by the cellulose fibres and impregnating the beads with tetraethyl orthosilicate and a neutral gemini surfactant under hydrothermal conditions. Thereby a strong, porous article is produced comprising a strong, porous carrier and a second porous material nested within and structurally supported by the pore walls of the carrier.

Whitman (US 5 399 535) discloses the production of reticulated ceramic products by using solid porous matrices (SiO_2, zeolites or crosslinked acrylic polymer particles) as templates.

A ceramic product having a high degree of anisotropy, namely continuous capillaries, cannot be obtained using any of the above mentioned processes, since these processes do not contain process step b) of claim 1 of the application or a corresponding measure able to impart unidirectional anisotropy to the resulting gel. Moreover, none of the documents relied upon by the office action teach or suggest methods of making a porous ceramic material comprising a process step of impregnating the gel body with a

volatile, water-miscible solvent. Thus, none of the cited documents anticipate the ceramic materials or methods of manufacture provided by the instant invention.

None of the cited references, alone or in combination, teach or suggest methods of preparing an anisotropic porous ceramic material. More particularly, none of the cited documents, taken alone or in combination, teach or suggest the use of a concentration gradient to impart anisotropy to a gel. Thus, ceramic materials and methods of making same would not have been obvious to one of ordinary skill in the art based on any combination of the cited documents.

Thus, for at least the reasons discussed herein, the ceramic materials and methods of making and using same are patentable over each of the cited documents taken alone or in combination. Applicants respectfully request withdrawal of the rejections and reconsideration of the claims.

Although it is not believed that any additional fees are needed to consider this submission, the Examiner is hereby authorized to charge our deposit account no. 04-1105 should any fee be deemed necessary.

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Respectfully submitted,

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